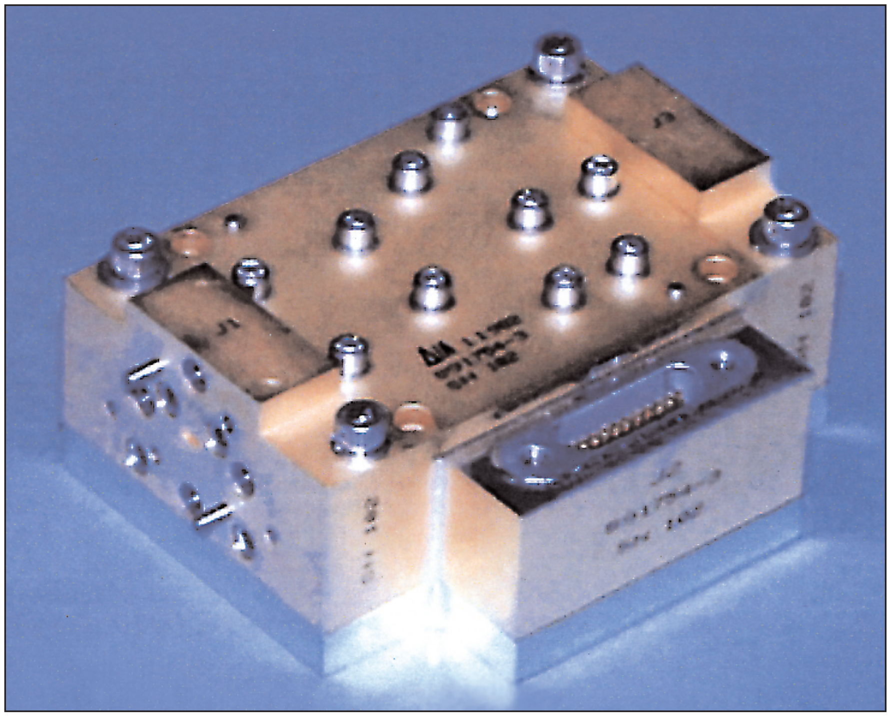
High-Performance Solid-State W-Band Power Amplifiers

Outputs ≥240 mW are available at frequencies from 71 to 106 GHz.

NASA's Jet Propulsion Laboratory, Pasadena, California

The figure shows one of four solid-state power amplifiers, each capable of generating an output power ≥240 mW over one of four overlapping frequency bands from 71 to 106 GHz. (The bands are 71 to 84, 80 to 92, 88 to 99, and 89 to 106 GHz.) The amplifiers are designed for optimum performance at a temperature of 130 K. These amplifiers were developed specifically for incorporation into frequency-multiplier chains in local oscillators in a low-noise, far-infrared receiving instrument to be launched into outer space to make astrophysical observations. The designs of these amplifiers may also be of interest to designers and manufacturers of terrestrial W-band communication and radar systems.



This **Photograph Shows One of the Amplifiers** described in the text. A WR-10 waveguide input port is on the left end. The output port is on the right end, facing away. DC input and sensing conductors enter the package via a 21-pin connector. (Module dimensions: 20 × 49 × 60 mm.)

Each amplifier includes a set of six high-electron-mobility transistor (HEMT) GaAs monolithic microwave integrated-circuit (MMIC) chips, microstrip cavities, and other components packaged in a housing made from A-40 silicon-aluminum alloy. This alloy was chosen because, for the original intended spacecraft application, it offers an acceptable compromise among the partially competing requirements for high thermal conductivity, low mass, and low thermal expansion. Problems that were solved in designing the amplifiers included designing connectors and packages to fit the available space; designing microstrip signal-power splitters and combiners; matching of impedances across the frequency bands; matching of the electrical characteristics of those chips installed in parallel power-combining arms; control and levelling of output power across the bands; and designing the MMICs, microstrips, and microstrip cavities to suppress tendencies toward oscillation in several modes, both inside and outside the desired frequency bands.

This work was done by Todd Gaier, Lorene Samoska, Mary Wells, Robert Ferber, John Pearson, April Campbell, and Alejandro Peralta of Caltech for **NASA's Jet Propulsion Laboratory** *and Gerald Swift, Paul Yocum, and Yun Chung of TRW, Inc. Further information is contained in a TSP (see page 1).*
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Microbatteries for Combinatorial Studies of Conventional Lithium-Ion Batteries

Thousands of combinations of battery materials can be evaluated economically.

NASA's Jet Propulsion Laboratory, Pasadena, California

Integrated arrays of microscopic solid-state batteries have been demonstrated in a continuing effort to develop microscopic sources of power and of voltage reference circuits to be incorporated into low-power integrated circuits. Perhaps even more importantly, arrays of microscopic batteries can be fabricated and tested in combinatorial experiments directed toward optimization and discovery of battery materials.

The value of the combinatorial approach to optimization and discovery has been proven in the optoelectronic, pharmaceutical, and bioengineering industries. Depending on the specific application, the combinatorial approach can involve the investigation of hundreds or even thousands of different combinations; hence, it is time-consuming and expensive to attempt to implement the combinatorial approach by building and testing full-size, discrete cells and batteries. The conception of microbattery arrays makes it practical to bring the advantages of the combinatorial approach to the development of batteries.